VOLUME 60
NUMBER 2

WHOLE NO. 278
1946

Psychological Monographs

JOHN F. DASHIELL, *Editor*

Factors Associated with Binet IQ Changes of Preschool Children

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Published by

THE AMERICAN PSYCHOLOGICAL ASSOCIATION, INC.

Publications Office

1515 MASSACHUSETTS AVE., N.W., WASHINGTON 5, D.C.

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FACTORS ASSOCIATED WITH BINET IQ CHANGES OF PRESCHOOL CHILDREN

I. The Relation of Selected Experiences to IQ Change

By BETH L. WELLMAN and BOYD R. McCANDLESS

This study represents a preliminary search for factors that may be associated with changes in Binet IQ of preschool children. The study is divided into two units. In the first unit an attempt is made to get below the blanket term "preschool attendance" to measure some of the specific experiences of the children and to determine whether these measured experiences are related to the manner in which the children change in IQ. The experiences studied are selected types of contacts received by the preschool child from his teachers and from other children in the preschool groups. The second unit of the study attempts to assay the role of vocabulary in IQ change.

The general problem arose out of a desire to make a more complete explanation than has yet been made of the upward changes in IQ by preschool groups during periods of preschool enrollment. It is not the purpose of the present article to review the literature on these changes, since a summary has been published elsewhere by one of the authors (5). It may be said, however, that a careful search through the literature reveals a large number of studies presenting mean IQ changes by preschool groups and by nonpreschool groups of comparable ages. As might be expected, there is considerable variation from study to study in the amount of mean change obtained, the methodology of the study, the tests used and the interpretations placed upon the results. A brief statement of the findings on Binet IQ changes is pertinent here, since the present study utilizes the 1937 Stanford revision of the Binet scale.

Studies using the Kuhlmann revision of the Binet scale, the 1916 Stanford revision or the 1937 Stanford revision have been made by a number of investigators in various sections of the country. Briefly, the following statements may be made from the evidence presented in the literature on Binet IQ changes: (1) the pattern of mean changes for preschool groups differs from that for nonpreschool groups, although there is overlapping of results; (2) groups enrolled in preschool almost invariably have shown a positive change in IQ, the amount varying from a negligible quantity to a relatively large change; (3) the mean of all preschool group changes reported in the literature to date represents an increase of five to six IQ points over a period of approximately one year of enrollment; (4) nonpreschool groups usually have made changes of small magnitude, sometimes positive and sometimes negative, rarely changing as much as three points; (5) the mean of all nonpreschool group changes reported in the literature to date represents approximately one to two points.

Since the present study uses as subjects children attending the preschool laboratories of the Iowa Child Welfare Research Station, a brief statement of the past findings on Binet IQ changes of children attending these preschools may be appropriate here. For a more complete discussion the reader is referred to a recent summary by Wellman (4) covering the first seventeen years of the preschools, when the 1916 revision of the

Stanford-Binet and the Kuhlmann revision were used. The summary shows that the mean gain in IQ for 652 newly entered children from the time of their test in the fall, shortly after entering preschool to their second test in the spring six months later was +6.6 points. The group may be subdivided according to the revision of the Binet scale used, as follows: 124 children who received the Kuhlmann revision at both testings and who made a mean increase of +8.3 points in IQ; 450 children who received the 1916 Stanford revision at both testings and who made a mean increase of +6.0 points; and 78 children who were tested in the fall on the Kuhlmann revision and in the spring on the 1916 Stanford revision, who made a mean gain of +6.8 points in IQ.

For 317 of these children tests were available in the spring and the following fall, an interval of six months including the summer vacation. The vacation period was flanked on each end by some weeks of attendance but contained a central block of two to four months of complete non-attendance, the length depending on whether or not the child attended a summer session of six to eight weeks. The mean change in IQ was −1.1 points. Also, two independent groups of nonpreschool children from similar socioeconomic levels residing in Iowa City and sampled several years apart (one in 1934 by Wellman and the other in 1940 by Messenger) did not gain significantly in IQ (−1.8 points and +2.0 points) but rather showed changes similar to the spring-fall changes of the preschool children.

Children who attended preschool for two successive years made a mean gain of +10.5 points (N = 201); those attending for three years made a mean gain of +9.9 points (N = 55). Factors having to do with the revision of the test used, testing conditions, time of testing, selection of children, bias of examiners, and measured parental characteristics were examined and did not appear to explain the differences found during periods of attendance and nonattendance.[1] Similar results have been obtained from the more recent use of Form L of the 1937 revision, as will be noted from the results presented in this study.

So far, there has been little attempt in the literature to differentiate the nature of preschool experience from nonpreschool experiences, or to analyze the conditions or experiences that impinge upon the child in preschool or characterize his school life. A recent study by Landreth, Gardner, Eckhardt and Prugh (1) compared teacher-child contacts in a university nursery school with those in a WPA nursery school. The contacts were classified according to type, methods and goals. They found differences in teacher contacts in the two schools but did not measure the effects upon the child. A study by Thompson (3) at the State University of Iowa contained observational records on a large array of teacher-child and child-child contacts experienced by two groups of four-year-old children under different experimental programs of teacher guidance. The items of observation were selected with specific reference to social and emotional behavior and personality growth. Thompson found significant differences in the social and emotional behavior development of the two groups but no difference in IQ change. The relevance of his findings to the present study is discussed later in this article.

The specific approach of this article is that of the study of individual differ-

[1] These factors are discussed in the article by Wellman (4).

ences within a group rather than of gross group changes. During a given preschool year there are wide individual differences in IQ change from fall to spring tests; for example, in the year 1940-41, the changes in IQ on Form L by 36 three- and four-year-old children ranged from a loss of 15 points to a gain of 39 points, eight of the children losing and 28 gaining in IQ. Can some portion of the differences be accounted for by differences in measured experiences of the children during the hours that they attend preschool?

A number of considerations governed the choice of this particular approach to the problem of environmental factors. It should be emphasized that the numerous technical difficulties inherent in the problem preclude a complete answer to the main problem; at best the results could yield only an incomplete and partial answer to the main problem of the dynamics of preschool impacts upon the child's intelligence. The methodology and some of its limitations are sketched briefly below.

1. *The method chosen was that of direct observation.*

2. *Individual differences within a preschool group were studied.* The problem set for the present investigation is a difficult one technically; namely, to account for differences in IQ change within a group in which the general tendency is towards gain. The question for which an answer is sought may be stated broadly as "Why do some children in the preschools gain more than other children?" Some of the differences in IQ change are of course accounted for by unreliability of the tests, but there are differences over and above those accounted for by this factor. Detailed precaution was taken to make the examinations as adequate as possible in every respect.

3. *The study is concerned with frequency of occurrence of certain objective experiences of the preschool child.* It is assumed that, other things being equal, the children who receive more of "stimulating" experiences may be expected to be affected more than the children who receive fewer of them. This study does not attempt to deal with "other things" except as they are represented in initial IQ, age, previous attendance in preschool and vocabulary-mental age constellations.

4. *Only certain selected experiences are included within the present framework.* No attempt has been made to locate *all* of the environmental impacts that might be related to IQ increase; rather, a few experiences were selected that the authors believed might be expected most logically to contribute. The selection was governed by the following considerations.

5. *The experiences studied were those received by the child through his contact with preschool teachers and other children.* The contacts recorded were mainly those that were explicitly verbalized by others. A few non-verbalized experiences were included, however, where there was demonstration of the solution of a problem, where the child was assisted over a difficult step in a process in order that he could arrive at a solution, and where the teacher assisted in routine situations that would have been time consuming for the child to manage alone and probably not fertile in providing new ideas, thus conserving the child's time for more constructive activities. The specific behaviors recorded are defined and discussed later in this article.

6. *The variables selected were those the authors thought most closely relevant*

to the abilities measured by the Binet tests. The hypothesis was that those experiences within the preschool that tend to improve vocabulary, number concepts and other concepts, generalizations, abstractions and general information will be the ones most likely to yield positive relations to IQ increase on the Binet scales,[2] since these skills in general characterize the test content of Form L. Form L is heavily impregnated with items requiring vocabulary and other verbal skills.[3]

7. *The categories included were those believed to be "intellectual" (as opposed to "social") in content.* The preschool child receives a great many verbal contacts from the teacher and from other children that might be classified under the categories used in this study, but which are concerned with social relations. For example, the teachers provide the children with many instances of information in regard to social techniques and relations with other children. These may be contrasted with items of information about objects, things and events. Because of the results obtained by Thompson (3) and some subsequent analyses of his data into "social" and "intellectual" content[4] the decision was made to exclude contacts "social" in content.

8. *The study assumes that the preschool teachers are skillful in adapting their procedures to the level of the children.* The observers did not attempt to pass judgment on the suitability of a given contact for a particular child. Rather, it was assumed that by and large the preschool teacher adapts the content of her contacts to the level of the children: for example, when she gives information to a child, that it is not too advanced so that it is "over his head" nor pitched at a level so low that it adds nothing to his already existing store of knowledge. If either of these conditions existed systematically it would tend to reduce any possible relationships between the environmental variables and IQ change.

9. *The experiences in preschool are superimposed upon a background of generally good home experiences.* The children come preponderantly from the professional classes and from homes maintaining relatively high educational and cultural standards. There are no wealthy homes and no impoverished homes among those of the children included in the study. The children are generally high in IQ, but there is a wide range among the subjects of this study (85 to 166). From data on certain home experiences gathered on the subjects but not incorporated in this article, there is evidence to indicate a rather wide range in home experiences.

PLAN OF OBSERVATIONAL STUDY

Five categories of teacher-child contacts and eight categories of child-child contacts constituted the experiences ob-

[2] The evidence in this study tends to disprove this hypothesis.

[3] Merrill (one of the authors of the Form L standardization) is reported by McNemar as selecting the test items that could be classified as nonverbal or "less verbal." Not counting alternate tests, there are 54 test items in the levels Year III through Year IX, the effective range for the children of the present study. Of these 54 items, Merrill clasified 12, or less than one-fourth, as nonverbal or "less verbal." See McNemar, Quinn: The revision of the Stanford-Binet scale: an analysis of the standardization data. Boston: Houghton Mifflin Co., 1942. Pp. 185 (142-144).

[4] The writers are indebted to Dr. Thompson for making these analyses for them. His analyses indicated that while the group of children under the one type of teacher guidance making the most favorable changes in social and emotional behavior received significantly more contacts "social" in content than the other group, they did not differ in "intellectual" contacts. Neither did they differ in IQ change.

served in this study. The categories were derived after extensive running account records had been kept on a number of children in preceding years.[5] Each contact was considered from the standpoint of the child who was the recipient. The teacher-child contacts consisted of instances in which a teacher channelized or structured a situation for a child, gave him help, gave information, asked a leading question and gave directions. The child-child contacts consisted of experiences in which another child made certain verbalizations or provided a demonstration in the presence of the observed child. They included giving information, asking general or conceptual information from the observed child, verbalizing the outcome of an activity, varying or modifying a joint enterprise, channelizing, giving help, using a number concept correctly, generalizing, using an imaginative concept and discovering the solution to a problem.

A typed memorandum of several pages explaining the system of observations, defining the categories and giving several examples of inclusions and exclusions was prepared and placed in the hands of each observer. Only brief definitions and a few illustrative examples are included in the discussion below.

The categories of teacher-child contacts were:

1. Teacher channelizes activity and/or makes structuring suggestion: here the teacher orients the child as to his present or future situation. She introduces an element of order into an otherwise unclear state of affairs. Her method is usually that of indirect suggestion. Included are situations in which she points out alternative procedures, solutions and activities when these choices are not routines, mandatory activities or social procedures. Excluded is the question "What do you want to do now?" Examples: "Do you want this tied with one string or two?" To J and C, who have been trying futilely to arrange a pulley with a rope of inadequate length, "There is a longer piece of rope in the closet."

2. Teacher gives physical help: (a) of the type intended to clear or open the way for a constructive activity, such as inserting a rope in a pulley; (b) in order to conserve time, such as in dressing, and putting away toys in order to have time for the next activity. If help is verbal, it is included under other categories.

3. Teacher gives information. This covers information about things, objects, events, processes and sequences and descriptive adjectives and adverbs where these are applied specifically or illustrated. It includes giving of generalizations.

4. Teacher asks leading question. The teacher asks the child a question designed to cause him to think conceptually, to arrive at a solution of an unclear state of affairs, to see relationships, to generalize from information at hand, to apply information concerning one relationship to another relationship or to recall information previously learned.

5. Teacher gives simple directions. The teacher tells the child specifically what to do in a situation other than that of routine. By the term routines is meant situations for the preservation of order as well as for the general welfare of the children.

The eight categories of child-child contacts were as follows:

1. Another child (Child 2) gives information to or in the presence of the

[5] The running accounts and categories were originally the result of the teamwork of Boyd R. McCandless and George G. Thompson. Later they were narrowed to fit the limits of the present study.

observed child (Child 1). The instances are similar to those in the corresponding teacher-child item. Excluded are certain specified descriptive adjectives which are very common, such as good, bad, big, small, fast, and dry.

2. Child 2 asks general or conceptual information from Child 1. Questions dealing with whereabouts, family personnel, father's business and routines are excluded.

3. Child 2 verbalizes the outcome of an activity to the attention of Child 1.

4. Child 2 varies or modifies a cooperative, associative or parallel enterprise to the attention of Child 1; he channelizes the activity of Child 1 or gives help.

5. Child 2 uses a number concept correctly in the presence of and to the attention of Child 1.

6. Child 2 generalizes in the presence of Child 1.

7. Child 2 uses an imaginative concept in the presence of Child 1.

8. Child 2 discovers a solution in the presence of Child 1.

In group situations such as story groups, music and rest periods, observations were not recorded unless they met the following conditions: (1) the teacher addressed herself directly to a child in the group; (2) it was clear that the child recognized himself as a recipient of a contact.

Two methods of observation were used: (1) a short sample technique in which one child was the center of reference for a short period of observation, the contacts received by him from the teachers and from other children being recorded by tally under the appropriate categories, his score being the sum of contacts received on several such short periods; and (2) a technique of observation called "following the teacher," in which a teacher was the center of reference for a complete preschool day's session, her observed contacts being distributed among the prescribed categories, the child who received each contact being designated by his initials. Later, each child's score was computed by extracting the instances in which he was recipient.

The observations extended over the complete preschool year. In the short sample method, an attempt was made to distribute the observations so that each child's samples were representative of the different hours of the day. In the method of following the teacher the observer drew a time line after every five minutes of observation.

In 1940-41, the first year of the study, the method of short samples was used, the unit being five minutes. Forty such samples were obtained on each child. Because this method yielded a reliability figure lower than desired, the method of following the teacher was introduced in the second year of the study, 1941-42. However, this method did not yield a measure of child-child contacts. Since further data on child-child contacts were desired, it was decided to try simultaneously a short sample procedure in which the unit was extended to ten minutes and the total extended to 30 samples, or 300 minutes of observation per child as compared with 200 minutes in the 1940-41 data. In the third year of the study, 1942-43, the method of following the teacher was used exclusively. Each head teacher was observed for a total of 24 preschool days; likewise each of the two assistant teachers in a group was observed for 24 days.

SUBJECTS

The subjects were the children enrolled in two age groups of the preschool laboratories of the Iowa Child Welfare Research Station during the years 1940-

41, 1941-42 and 1942-43. All children who completed a preschool year were included.[6] The younger group enrolled children whose ages at the opening of the fall semesters were within the ranges of 35 to 49 months and the older group 43 to 58 months. The younger children attended morning sessions and the older children afternoon sessions.

Each group was under the supervision of a head teacher and two assistant teachers and in addition a limited amount of practice teaching was done by students in training for advanced degrees. The head teachers remained with the groups throughout the year, the assistant teachers changed in the middle of the year at the end of the semester. The same head teacher taught the younger groups in the first two years of the study.

Since this study spread over three calendar years, some of the same subjects were observed during two successive years. In cases where the same method of observation was used in records in two years, all duplicate children were removed from the computations reported in this article, only the first year's record on a given method being used for each child.

Sixty-six children were observed by the method of short samples, and 64 by the method of following the teacher; the total number of different children observed was 95.

INTELLIGENCE TESTS

Form L of the 1937 Stanford-Binet was administered to each child in the fall and again in the spring of each year. The preschools opened in September and the fall testing began after the children had had at least one week of attendance, most of the tests being given in October and November. The intervals between opening of preschool and time of test ranged from 11 to 72 days with a mean of 41 days. The spring tests took place in April and May. The intervals between fall and spring tests ranged from 4 to 7 months, with a mean interval of 5.6 months. All testing was done by graduate research assistants who were experienced examiners and who were either previously acquainted with the children or had spent some time in the group becoming acquainted with the children before testing.

OBSERVER AGREEMENT

Several observers participated in collecting the data. All were graduate student research assistants in the Iowa Child Welfare Research Station. Preliminary to collecting data in the main study, records were taken by observers working in pairs in order to determine the degree of observer reliability. The extent of agreement was expressed by the method of correlation between the number of contacts received by a child as recorded by one observer and the corresponding number as recorded by the other observer.

Five-Minute Samples. Table 1 states the agreement between observers on the five-minute sampling technique. The table is to be read as follows: Pair M-A observed together for a total of 106 samples, during which time 86 teacher contacts of the type included in this study were recorded for the children as observed by M and 88 by A; during the same periods of observation 195 contacts from other children were received by the observed children as recorded by M and 189 as recorded by A. The teacher contacts were distributed among 21 chil-

[6] The turnover in population was larger during these years than under usual peacetime conditions, due to the moving away of families and to transportation problems. All children enrolled at the beginning of the year were studied up to the time of removal.

TABLE 1

Agreement Between Observers in Five-Minute Samples

1940–41

Observers	No. Samples	No. Contacts Recorded	Range of Scores per Child	No. of Children	Correlation
Teacher-Child Contacts					
Pair M-A	106			21	.989
M		86	1–13		
A		88	1–13		
Pair M-K	54			18	.989
M		127	1–21		
K		122	1–21		
Pair A-G	102			26	.973
A		91	1–14		
G		88	1–14		
Pair A-T	37			16	1.000
A		39	1–10		
T		39	1–10		
Child-Child Contacts					
Pair M-A	106			26	.989
M		195	1–25		
A		189	1–26		
Pair M-K	54			20	.975
M		207	2–23		
K		207	2–25		
Pair A-G	102			16	.985
A		34	1–6		
G		35	1–6		
Pair A-T	37			13	1.000
A		17	1–3		
T		17	1–3		

dren, who received from one to 13 contacts each, and the contacts from other children were received by 26 subjects, the number received varying from one to 25 each according to the records of M and from one to 26 each according to the records of A. The correlation between observers M and A on teacher contacts was .989 and on child-child contacts also .989.

Pair A-T agreed perfectly on both teacher-child and child-child contacts. The remaining two pairs of observers agreed to the extent as expressed by correlations ranging from .973 to .989.

Pairs M-A and M-K selected situations in which they expected a large number of contacts, hence the average number of contacts per five minutes was higher for them than for the other observers, who merely took any available child.

Ten-Minute Samples. When ten-minute samples were used, three pairs of observers were tried out for observer reliability. Pair B-S obtained 34 samples, An-Gr 30 samples and G-H 31 samples. Only one pair (B-S) agreed to an extent comparable to the observers of the previous year. No further preliminary observations were required of this pair. The other pairs went through an additional process in which one of the authors of the study acted as a referee to clarify differences of definition. As a result of this experience, some supplementary definitions of categories were drawn up. Since it was then known that observer G would not participate in the main study, he was

dropped and cross-pairings were instituted. Observers H and Gr worked together during the clarification process; following this, pairs An-Gr and B-H made new sets of observations, as shown in Table 2. The correlations ranged from .899 to .958, with the exception of a perfect agreement between B and H on the small number of teacher contacts during their 10 samples, which in all probability represents an overestimation of their agreement on a larger sampling.

TABLE 2

Agreement Between Observers in Ten-Minute Samples
(After Clarification of Differences)

1941–42

Observers	No. Samples	No. Contacts Recorded	Range of Scores per Child	No. of Children	Correlation
Teacher-Child Contacts					
Pair B-S	34			16	.918
B		63	1–10		
S		58	1–8		
Pair An-Gr	20			10	.958
An		37	1–10		
Gr		36	1–11		
Pair B-H	10			3	1.000
B		5	1–3		
H		5	1–3		
Child-Child Contacts					
Pair B-S	34			13	.951
B		31	1–6		
S		30	0–6		
Pair An-Gr	20			12	.901
An		24	1–8		
Gr		23	1–5		
Pair B-H	10			8	.899
B		15	1–3		
H		17	1–5		

It will be noted that in 1941-42, although observers established reliability by the short sample method only, they subsequently utilized the same categories in gathering data for the main study by both techniques of short sample and following the teacher. The reasons for establishment of reliability in only the short sample situation were: (1) this situation included all of the categories to be used in both methods, whereas "following the teacher" did not include the child-child contacts; (2) the observers could render themselves less obtrusive and conspicuous when they could select a child for center of reference than when two were attempting to trail a teacher simultaneously.

Following the Teacher. In the third year of the study, 1942-43, since only the method of following the teacher was to be used, reliability of observers was established in this situation. Four pairs of observers participated. They made a few independent observations and then met with one of the authors for clarification of definitions and situations, following which they returned for further observation. The following total amounts of time were devoted to simultaneous ob-

servations during the period of training: Pair H-Ba 6½ hours, H-K 11¾ hours, Gr-W 7¼ hours, and Gr-E 9½ hours.

The degree of observer agreement in the last two hours for each pair is presented in Table 3. The correlations range from .934 to .961.

TABLE 3

Agreement Between Observers in Following the Teacher (Last Two Hours of Observation)

1942–43

Observers	No. Contacts Recorded	Range of Scores per Child	No. of Children	Correlation
Pair H-Ba			20	.942
H	95	1–21		
Ba	86	1–14		
Pair H-K			20	.961
H	137	1–22		
K	142	1–24		
Pair Gr-W			17	.952
Gr	88	1–14		
W	71	1–14		
Pair Gr-E			11	.934
Gr	102	1–38		
E	119	1–45		

Since in the subsequent analysis of results on following the teacher, it was planned to treat the categories separately, some expression of observer agreement on each category seemed desirable. However, the range of scores did not permit correlations for each category. As a substitute, Table 4 presents the number of contacts recorded under each category during the last two hours of simultaneous observation. It will be seen that the pairs of observers generally agreed quite well in the distribution of contacts, and that the greatest discrepancies were on the category information. Examination of the records of Pair Gr-W showed that Observer Gr recorded many more instances of information than Observer W and that whenever W recorded an instance it was almost always included by Gr. Before proceeding to the final collection of data, these two observers attempted to resolve this difference. They consulted with the other observers to insure that all were proceeding on a common basis. They then devoted an additional period of observation to recording information only; Observer Gr recorded 28 instances and Observer W recorded 24.

RELIABILITY OF SCORES

In 1940-41, the first year of the study, scores were based on 40 five-minute samples per child distributed throughout the year and distributed throughout the hours of the preschool day. Reliability

TABLE 4

Agreement Between Observers on Separate Categories in Last Two Hours of Observation in Following the Teacher

1942–43

	No. of Contacts Recorded							
	Pair		Pair		Pair		Pair	
	H	Ba	H	K	Gr	W	Gr	E
Channelizes	18	19	22	22	9	8	13	15
Help	35	33	13	14	12	12	23	19
Information	37	29	67	75	57	43	56	45
Leading Question	2	3	31	30	9	7	27	22
Directions	3	2	4	1	1	1	0	1
Total	95	86	137	142	88	71	119	102

of the scores was obtained by correlating the results on alternate observation periods and applying the Spearman-Brown prophecy formula. Complete observations were obtained on 34 children; two additional children on whom observations were available were not included in the reliability correlations, since they lacked one and two periods, respectively, of the required 40 periods. They were, however, included in the main study by making the slight corrections necessary to approximate the equivalent of 40 periods. The reliability for the combined five items of teacher-child contacts was disappointingly low, the Spearman-Brown correlation being only .298. The reliability on the combined eight items of child-child contacts was somewhat better but not high, being .660.

In 1941-42, the second year of the study, the unit samples were extended to ten minutes and the total observation time devoted to each child was 300 minutes, as compared with 200 minutes in the previous year. Thirty children, none of whom was included in the previous year, were studied. The reliability of 15 odd versus 15 even observation periods was better for teacher-child contacts (.809) but very low for child-child contacts (.228).

Reliability of scores by the method of following the teacher was computed by correlating the sums of contacts received on alternate observation days. Sixty-four different children received scores in the two years that this method was used. As stated previously, only the first year's record was used on each child. Each head teacher was observed for a total of 24 full preschool sessions distributed over the academic year. Likewise each of the two assistant teachers was observed for 24 days. The number of contacts received by each child in each observation day was extracted from the records. A child's score in the reliability is based upon 12 odd unit days versus 12 even unit days; a unit day is composed of the contacts received in one day from the head teacher plus the contacts received in one day each from the two assistant teachers.

The correlations using the Spearman-Brown prophecy formula are given in the following tabulation for each of the categories and for the sum of the categories. The reliabilities range from .79 for channelizing and for leading questions to .89 for directions. The sum of the five items yielded a reliability of .87. These reliabilities may be considered high enough for separate treatment of the different categories.

Item	Correlations, using Spearman-Brown formula 12 odd unit days vs. 12 even unit days N = 64
Channelizes	.79
Help	.87
Information	.84
Leading question	.79
Directions	.89
Sum of above items	.87

Since, in the second year of the study, both the short sample method and the method of following the teacher were used, it is of interest to determine to what extent the scores obtained by the two methods agree. No attempt was made to synchronize the observation times; an observation on a child by the short sample method may or may not have taken place on the same day that a teacher was being observed. However, the short sample method covered only ten minutes of his day with all teachers involved, while the other method covered the complete day's session but with only one teacher involved.

There were 30 children who received scores by both methods. The correlation between the two sets of scores was .83,

which indicates that the two methods distributed the children in similar fashion and that the scores on teacher contacts by each method can be considered as of satisfactory reliability. Considering the reliabilities of the two scores involved, this correlation is about as high as could be expected.

RESULTS BY SHORT SAMPLE METHOD

The relation between frequency of teacher-child contacts obtained by the method of short samples and IQ change is shown in Table 5, which gives the mean change in IQ for the children in each preschool group divided into those above and below the mean in number of teacher-child contacts on the combined five items.

TABLE 5
Relation Between Teacher-Child Contacts Obtained by the Method of Short Samples and IQ Change

Contacts	N	Mean Contacts	Mean Fall IQ	Mean Change in IQ
Younger Group 1940–41 (40 5-minute samples)				
44 and above	7	51.7	120.0	+16.1
Below 44	6	34.7	121.3	+14.0
Difference		17.0	−1.3	+2.1
Older Group 1940–41 (40 5-minute samples)				
38 and above	10	47.7	132.8	+0.9
Below 38	13	29.9	128.0	+3.3
Difference		17.8	+4.8	−2.4
Younger Group 1941–42 (30 10-minute samples)				
49 and above	5	78.8	102.2	+9.0
Below 49	9	31.9	119.3	+7.7
Difference		46.9	−17.1	+1.3
Older Group 1941–42 (30 10-minute samples)				
36 and above	6	48.3	124.3	+6.7
Below 36	10	28.9	118.4	+1.6
Difference		19.4	+5.9	+5.1

The younger group in 1940-41 was composed of 13 children who ranged in age from 37 to 49 months, with a mean of 41.7 months; the older group was composed of 23 children who ranged in age from 46 to 68 months, with a mean of 53.0 months. The fall IQ's of the younger group ranged from 98 to 153, with a mean of 120.6; the fall IQ's of the older group ranged from 109 to 159, with a mean of 130.1. Changes in IQ for the younger group ranged from +4 to +39 points, with a mean of +15.2 points; for the older group the changes in IQ ranged from −15 to +21, with a mean change of +2.3 points.

Teacher-child contacts ranged from 25 to 65 for the younger group in 1940-41, with a mean of 43.8; for the older group from 21 to 59, with a mean of 37.7. The children who were above the mean in teacher contacts in the younger group gained +2.1 points in IQ more than those below the mean; in the older group the difference was −2.4 IQ points. Obviously, these differences do not indicate a relationship between frequency of the teacher contacts obtained in this way and IQ change.

In 1941-42 the younger group was composed of 14 children who ranged in age

from 35 to 47 months, with a mean of 41.5 months; in fall IQ from 85 to 140, with a mean of 113.2; and in IQ change from −7 to +18, with a mean IQ change of +8.1 points. The older group in 1941-42 was composed of 16 children who ranged in age from 43 to 56 months, with a mean of 49.3 months; in fall IQ from 105 to 150, with a mean of 120.6; in IQ change from −16 to +31, with a mean IQ change of +3.5 points.

Teacher-child contacts in 1941-42 ranged from 17 to 128 for the younger group, with a mean of 48.6; and from 17 to 63 for the older group, with a mean of 36.2. The children who were above the mean in teacher contacts in the younger group gained +1.3 more IQ points than those below the mean; in the older group the children above the mean gained +5.1 more IQ points than those below the mean, but most of the difference is accounted for by one child who made an extremely large gain. These mean differences, while positive, are too small to be considered indicative of a relationship.

Unfortunately, it does not seem desirable to combine age groups in either year in the treatment of the data because of the difference in number of recorded contacts, IQ level and IQ changes; and combination of the results obtained by the different methods of sampling does not seem justifiable.

The conclusion is that these results do not point to a significant relationship between IQ change and frequency of teacher contacts of the type recorded here as measured by short samples.

TABLE 6

Relation Between Child-Child Contacts Obtained by the Method of Short Samples and IQ Change

Contacts	N	Mean Contacts	Mean Fall IQ	Mean Change in IQ
Younger Group 1940–41 (40 5-minute samples)				
38 and above	9	43.3	115.6	+12.2
Below 38	4	26.8	132.0	+21.7
Difference		16.5	−16.4	−9.5
Older Group 1940–41 (40 5-minute samples)				
49 and above	11	61.3	125.1	+3.4
Below 49	12	38.2	134.6	+1.2
Difference		23.1	−9.5	+2.2
Younger Group 1941–42 (30 10-minute samples)				
35 and above	7	47.7	114.9	+9.0
Below 35	7	22.5	111.6	+7.3
Difference		25.2	+3.3	+1.7
Older Group 1941–42 (30 10-minute samples)				
44 and above	9	52.9	121.8	+1.1
Below 44	7	31.6	119.1	+6.6
Difference		21.3	+2.7	−5.5

The relation between frequency of child-child contacts as obtained by the method of short samples and IQ change is shown in Table 6. In 1940-41 child-child contacts in the younger group group ranged from 21 to 50, with a mean of 38.2; in the older group the range was from 30 to 79 with a mean of 49.2. In 1941-42 the younger group ranged from 15 to 57 with a mean of 35.1 and the older

group from 21 to 61 with a mean of 43.6. Differences in IQ change between the children above and below the mean respectively in child-child contacts were as follows: for the younger group in 1940-41 −9.5 points, for the older group in 1940-41 +2.2 points, for the younger group in 1941-42 +1.7 points, and for the older group in 1941-42 −5.5 points. There appears to be no systematic relationship between IQ change and the frequency of child-child contacts of the type recorded in this study.

TABLE 7

Mean Teacher-Child Contacts for the Different Preschool Groups by the Method of Following the Teacher

Group	N	Fall IQ	Change in IQ	Channelizes	Help	Information	Leading Question	Directions	Total
Younger 1941–42	14	113.2	+8.1	56.6	61.1	79.6	76.9	49.4	323.5
Younger 1942–43	13	122.2	+7.9	51.3	61.2	83.0	34.8	14.1	244.4
	27	117.5	+8.0	54.0	61.1	81.2	56.6	32.4	285.4
Older 1941–42	21	123.1	+0.6	49.4	43.6	82.2	52.5	39.6	267.3
Older 1942–43	16	122.2	+3.2	47.6	34.8	131.4	47.7	10.4	271.9
	37	122.7	+1.7	48.6	39.8	103.5	50.4	27.0	269.3

RESULTS BY METHOD OF FOLLOWING THE TEACHER

There were 64 children who were studied by the method of following the teacher. The mean number of teacher contacts received by each preschool group is given in detail in Table 7, together wth the mean fall IQ and change in IQ. It will be noted that the two younger groups received the highest and lowest total number of teacher contacts, respectively, but did not differ in IQ change. The IQ changes of the younger groups were greater than those of the older groups. There is no indication from this table of any relationship between frequency of teacher contacts of the types studied here and IQ change.

There were large individual differences in the number of teacher contacts received. For the entire group of 64 children the range of scores on item 1, channelizing or structuring a situation, was from 10 to 118, with a mean of 50.9. On item 2, gives help, the range was from 10 to 98, with a mean of 48.8; on item 3, gives information, from 13 to 302, with a mean of 94.1; on item 4, asks leading or problem question, from 5 to 151, with a mean of 53.0; on item 5, gives simple directions, from 2 to 94, with a mean of mean of 29.3; on the sum of the five items, from 48 to 660, with a mean of 276.1. Since the period between fall and spring intelligence tests was on the average six months, the number of unit observation days per child (24 days) represented approximately one-fifth of the calendar preschool days over which changes in IQ were studied.

The fall IQ's of the children ranged from 85 to 160, the spring IQ's from 88 to 157, and the changes from −18 to +31. The mean fall IQ was 120.5, the mean spring IQ 124.9 and the mean change in IQ +4.4 points. Twenty-one children, or 33% of the group, changed +10 or more points, while 6 children, or 9% of the group, changed −10 or more points.

All of the items of teacher contacts were positively interrelated, the correlations ranging from .096 to .726 (Table 8). There was little correlation between the number of items of information and the items of direction received by the children, the correlation being .096. The amount of information and the amount of help received correlated .286, significant at the 5% level of confidence. All other correlations ranged from .472 to .726 and were significant at the 1% level of confidence, indicating that in general children who received a large amount of contacts of one type tended to receive a large number of contacts of other types also.

TABLE 8

Intercorrelations of Scores on Items Obtained by the Method of Following Teacher

N = 64

	Help	Information	Leading Question	Directions
Channelizes	.705	.567	.726	.472
Help		.286	.510	.538
Information			.543	.096
Leading Question				.620

Correlations between teacher contacts and fall IQ, spring IQ and change in IQ for the younger and older groups separately and combined are given in Table 9. Only one correlation in the table is significant at the 5% level of confidence, that between fall IQ and directions for the younger groups where the correlation is −.403, the teachers tending to give more directions to the children with lower IQ's.

For the combined groups, the correlations with fall IQ tend to be negative, but low and not significant. With spring IQ the correlations also tend to be negative and slightly reduced over the correlations with fall IQ. The correlations of teacher contacts with IQ change are all low and insignificant. With the sum of five categories of teacher contacts, fall IQ correlates −.124, spring IQ −.059 and change in IQ +.044.

Fall IQ and IQ change were not related in this group, the correlation being −.002.

The conclusion to be drawn from these correlations is that frequency of teacher contacts of the type studied here was not related to IQ status or to IQ change.

RELATION OF TEACHER CONTACTS TO VOCABULARY CHANGE

The Smith-Williams vocabulary test was administered in the fall of 1942 and again in the spring of 1943, near the time

TABLE 9

Correlation of IQ and IQ Change with Teacher-Child Contacts by Method of Following Teacher

Item	Younger Groups N = 27			Older Groups N = 37			Combined Groups N = 64		
	Fall IQ	Spring IQ	IQ Change	Fall IQ	Spring IQ	IQ Change	Fall IQ	Spring IQ	IQ Change
1. Channelizes	−.178	−.150	−.095	−.209	−.074	+.142	−.206	−.120	+.075
2. Help	−.098	−.204	−.296	−.139	−.015	+.145	−.191	−.092	+.123
3. Information	−.062	−.097	−.149	+.006	+.090	+.117	+.018	+.019	−.032
4. Leading Question	−.126	−.109	−.033	−.033	+.051	+.067	−.113	−.058	+.022
5. Directions	−.403	−.366	−.045	−.018	−.002	+.003	−.217	−.203	−.022
Total 1–5	−.204	−.221	−.137	−.045	+.045	+.126	−.124	−.059	+.044

of the intelligence tests. The vocabulary test consists of 84 words selected by Williams (6) from a longer series presented by Smith (2). It is arranged in two forms, both of which were used in this investigation at each testing period.[7]

Thirty-four children were tested. This group included all children who were enrolled in two preschool groups during the year 1942-43, who remained throughout the year and were thus available for both fall and spring tests. In the fall their ages ranged from 37 to 61 months, with a mean of 48.6; in the spring from 42 to 66 months, with a mean of 53.5 months. Their mean vocabulary score in the fall was 37.4, in the spring 44.1, representing a mean gain of 6.6 words on the scale. The range in vocabulary scores in the fall was from 12 to 53 and in the spring from 24 to 58.

In order to relate vocabulary scores to mental ages, the mental age of each child was corrected to the date of his vocabulary test, on the assumption of constancy of the IQ over this brief period. The corrections were slight; in the fall no correction was necessary for 17 children, one child's obtained mental age was reduced by one month, and 16 children's obtained mental ages were increased by one month; in the spring no correction was made for 33 children, one child's mental age being increased by one month.

The correlation for the 34 children between fall vocabulary and fall mental age was .716, between spring vocabulary and spring mental age .758, and between change in mental age and change in vocabulary .085. Thus, although vocabulary score was related to mental age status, there was no appreciable relationship between change in vocabulary during the preschool year and change in mental age. Fall vocabulary was related to spring vocabulary to the extent of a correlation of .905.

	r
Fall vocabulary with fall mental age	.716
Spring vocabulary with spring mental age	.758
Change in vocabulary with mental age change	.085
Fall vocabulary with spring vocabulary	.905
Fall vocabulary with change in vocabulary	−.351

The relation between teacher contacts and fall and spring vocabulary scores and vocabulary change is given in Table 10. Teacher contacts in the categories of giving information and asking leading questions were positively related to fall vocabulary, while the contacts in the other three categories were negatively related to fall vocabulary. Only one of these correlations was significant at the 1% level of confidence; namely, the teachers tended to give more help to the children who were relatively lower in vocabulary. The sum of the five categories of teacher contacts were not related to fall IQ, the correlation being +.050.

There was a slight positive correlation (+.139) between spring vocabulary and the sum of the five items of teacher contacts and a correlation of +.197 between the sum of teacher contacts and change in vocabulary. It will be noted that each category was slightly better correlated with spring vocabulary than with fall vocabulary; where a positive correlation existed in the fall, the correlation in the spring was slightly higher and where a negative correlation existed in the fall, the correlation in the spring indicated a slight reduction in the negative relationship. The correlations with change in vocabulary were all positive ranging from +.132 for directions to +.346 for channelizes. The latter correlation was significant at the 5% level of confidence.

[7] The examiners found it desirable to draw up some supplementary instructions for scoring, in order to cover responses for which the manual does not specifically provide and to insure comparable scoring by different examiners.

It seemed evident from inspection of the scores that the relationship between teacher contacts and vocabulary change differed so as to distinguish between the children who were experiencing their first year in preschool and those who had been enrolled in previous years. Consequently correlations were run separately for the eighteen children who were new to preschool. These correlations are also given in Table 10. For these children the correlations between the separate categories of teacher contacts and change in vocabulary ranged from +.348 to +.579, but due to the small number of cases only the latter correlation was statistically significant at the 5% level of confidence or above. With the sum of the five categories the correlation for change in vocabulary was +.475, significant at the 5% level of confidence.

The interpretation of these correlations is affected by the fact that there was a negative correlation between contacts and fall vocabulary and also a negative correlation between fall vocabulary and vocabulary change. It will be noted, however, that the two items gives information and asks leading questions which showed a very slight relationship with fall vocabulary were positively related to change in vocabulary to the extent of .408 and .348.

A further consideration is the fact that because of the small number of children who were new to preschool the correlation between total contacts and vocabulary change is greatly affected by one extreme deviate, a child who made the highest vocabulary change in the group but who received a small number of teacher contacts. The effect of this child on the relationship, as shown by the accompanying scattergram in Figure 1, is to obscure the regularity of the relationship which exists for the remainder of the group.[8]

In view of the various considerations, it cannot be stated conclusively that there is a significant relationship between teacher contacts and vocabulary change for children new to preschool, but the possibility is strongly suggested.

TABLE 10

Relation of Vocabulary Scores on Smith-Williams Test to Teacher Contacts by Method of Following Teacher

	Total Group N=34 Vocabulary			Children New to Preschool N=18 Vocabulary		
	Fall	Spring	Change	Fall	Spring	Change
Channelizes	−.257	−.102	+.346**	−.531**	−.386	+.413
Help	−.494*	−.404**	+.262	−.549**	−.432	+.383
Information	+.193	+.243	+.143	−.089	+.088	+.408
Leading question	+.230	+.309	+.176	−.043	+.102	+.348
Directions	−.328	−.280	+.132	−.581**	−.362	+.579**
Total	+.050	+.139	+.197	−.321	−.136	+.475**

* Significant at 1% level of confidence.
** Significant at 5% level of confidence.

[8] In order to obtain a numerical estimate of the effect, the correlation was recomputed omitting this child. The resultant correlation was +.829, indicating a high relationship between teacher contacts and change in vocabulary for the remainder of the group. When his child was omitted, the correlation of teacher contacts with fall vocabulary was not changed, the correlation being −.324, and the correlation with spring vocabulary was changed slightly, to −.057.

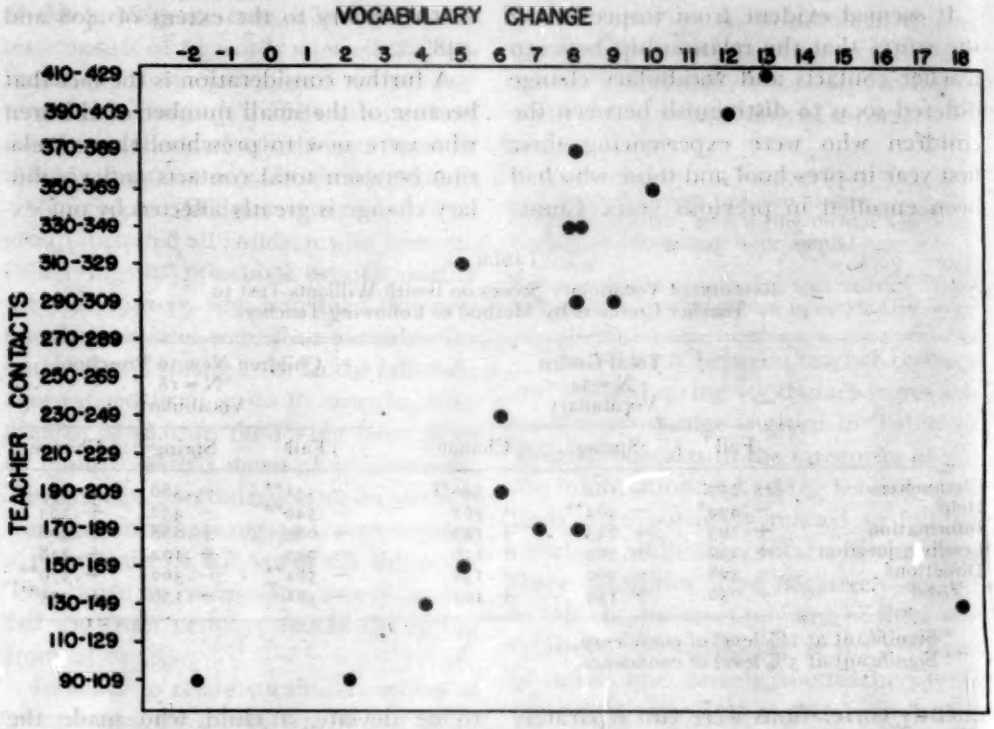

FIG. 1. Relation of teacher contacts to vocabulary change for children new to preschool

SUMMARY AND CONCLUSIONS

The purposes of the investigation were to study some factors that might be associated with Binet IQ changes of preschool children. The report of the investigation is divided into two units. The first unit, reported here, had as its purposes: (1) to measure selected experiences of the child while in preschool and to determine to what extent these experiences were related to IQ change; and (2) to study the relation of these experiences to vocabulary. The second unit, to be reported later, studied the role of vocabulary in IQ change.

The experiences studied were selected types of teacher-child and child-child contacts which the authors believed might be relevant to intelligence and particularly to the verbal aspects of intelligence.

Two methods of observation were utilized, a short sample technique in which one child was the center of reference for a period of five or ten minutes, and a method called "following the teacher" in which a preschool teacher was observed for a complete preschool day as a unit of observation. The subjects who were studied by the short sample method were 66 children ranging in age from 35 to 58 months, on 36 of whom 40 5-minute samples were obtained per child and on 30 of whom 30 10-minute samples were obtained. Sixty-four children were studied by the method of following a teacher. A child's score was based upon contacts recorded during 24 unit days of observation of three teachers.

Form L of the 1937 Stanford-Binet was administered to each child in the fall of

the year and again in the spring, after an average interval of 5.6 months.

No relationship was found between IQ change and frequency of teacher-child contacts or child-child contacts.

The Smith-Williams vocabulary test was administered in the fall and again in the spring to 34 children ranging in age from 37 to 61 months. Between vocabulary score and mental age a correlation of .716 was obtained for the fall measures and .758 for the spring measures. There was, however, no relationship between change in vocabulary and change in IQ, the correlation being .085.

Teacher contacts showed a correlation of +.475 with vocabulary change for 18 children all of whom were new to preschool.

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FACTORS ASSOCIATED WITH BINET IQ CHANGES OF PRESCHOOL CHILDREN

II. The Role of Vocabulary in IQ Change

By BETH L. WELLMAN and BOYD R. McCANDLESS

In the course of working with the data in a study of the relation of selected experiences of preschool children to their changes in IQ[1] it became apparent that children who were high in vocabulary for their mental age were making the more favorable changes in IQ. Consequently, it was decided to study this phenomenon more in detail.

The subjects were 34 children who were enrolled in the preschools of the Iowa Child Welfare Research Station. Each child received Form L of the 1937 Stanford-Binet in the fall of the year and again in the spring. Each child also received the Smith-Williams vocabulary test in the fall and spring within a month of the time of the intelligence test. The ages of the children at the time of the fall vocabulary test ranged from 37 to 61 months, with a mean of 48.6; at the time of the spring test from 42 to 66 months, with a mean of 53.5 months. Their vocabulary scores in the fall ranged from 12 to 53 words with a mean of 37.4 words; in the spring the range was from 24 to 58 words, with a mean of 44.1 words. Fall IQ's ranged from 93 to 150, with a mean of 123.9, and spring IQ's from 92 to 157, with a mean of 128.2. IQ changes ranged from −11 to +20, with a mean of +4.3 points.

[1] Wellman, Beth L. and McCandless, Boyd R. Factors associated with Binet IQ changes of preschool children. I. The relation of selected experiences to change in IQ.

VOCABULARY-MENTAL AGE STATUS IN RELATION TO IQ CHANGE

In order to study the role of vocabulary-mental age relationships in IQ change, sigma scores on vocabulary and on mental age were computed. If the child's vocabulary sigma score in the fall was higher than his mental age sigma score, the difference was considered as a positive V-MA score; if his vocabulary sigma score was lower than his mental age sigma score the difference was considered as a negative V-MA score.[2]

The composition of the positive and negative groups with respect to mean age, mental age and vocabulary score in the fall was as shown in table below.

The 18 children who in the fall had positive V-MA scores had a mean fall IQ of 122.0 and gained +7.6 points in IQ from fall to spring. The 16 children with

[2] Children in the positive V-MA group are not necessarily all high in vocabulary when this variable is considered alone. For example, a child with a vocabulary sigma score of −1.00 and an MA sigma score of −1.50 would be in the positive V-MA group, since his vocabulary position is higher than his MA position (V-MA is +.50), while a child with a vocabulary sigma score of +2.00 and an MA sigma score of +2.25 would be in the negative V-MA group (V-MA is −.25).

Group	N	Fall CA Mos.	Fall MA Mos.	Fall IQ	Fall Vocabulary Score
Positive V-MA	18	46.9	56.8	122.0	40.4
Negative V-MA	16	50.4	63.4	126.0	34.1
Difference		−3.5	−6.6	−4.0	+6.3

negative V-MA scores had a mean fall IQ of 126.0 and changed only +0.6 IQ point. Application of Fisher's t test technique[3] to the IQ changes yielded a t of 2.71, which indicates a difference in IQ gain between the two V-MA groups significant at the 1% level of confidence.

Group	N	Fall IQ	IQ Change
Positive V-MA	18	122.0	+7.6
Negative V-MA	16	126.0	+0.6
Difference		−4.0	+7.0
			t=2.71

The correlation between fall V-MA and change in IQ was +.389, significant at the 5% level of confidence[4] (Table 1). Fifteen of the 18 children who had positive V-MA scores showed a gain in IQ, while only six of the 16 children with negative V-MA scores showed a gain.

The children whose vocabulary sigma score was +.50 or more above their mental age status gained +8.8 points in IQ, all of them gaining. Those whose V-MA was +.01 to +.49 gained +6.1 points, 62% of the children gaining. Those whose V-MA was negative −.01 to −.49 gained +4.6 points, 60% of them gaining. Those whose vocabulary sigma score was −.50 or more below their mental age sigma score showed a slight loss in IQ, −1.2 points, only 27% of them gaining.

It will be noted that in this group the changes in IQ were not particularly related to the size of the fall IQ; the children with V-MA's from +.01 to +.49 had a mean fall IQ approximately the same as

TABLE 1

Correlations Between Vocabulary-Mental Age Status, IQ Change and Teacher Contacts for Total Group and for Children New to Preschool

	N	r	Children New to Preschool N	r
V-MA and IQ				
Fall V-MA and change in IQ	34	+.389**	18	+.366
Fall V-MA and fall IQ	34	−.283	18	−.055
Fall IQ and change in IQ	34	−.172	18	+.126
Fall V-MA and spring V-MA	34	+.727*	18	+.555**
Fall V-MA and change in V-MA from fall to spring	34	−.469*	18	−.449
V-CA and IQ				
Fall V-CA and change in IQ	34	+.234	18	+.381
Fall V-CA and fall IQ	34	+.565*	18	+.657*
Fall V-CA and spring V-CA	34	+.879*	18	+.926*
Fall V-CA and change in V-CA from fall to spring	34	−.174	18	−.206
Change in V-CA from fall to spring and change in IQ	34	+.068	18	−.059
Teacher Contacts and V-MA				
Teacher contacts and fall V-MA	34	−.098	18	−.465
Teacher contacts and spring V-MA	34	+.135	18	+.082
Teacher contacts and change in V-MA from fall to spring	34	+.284	18	+.609*

* Significant at the 1% level of confidence.
** Significant at the 5% level of confidence.

[3] Lindquist, E. F. Statistical analysis in educational research. Boston, Mass.: Houghton Mifflin Co., 1940, 54-57.

[4] Both V-MA's and IQ changes involved positive and negative signs.

V-MA	N	Fall IQ	IQ Change	% Gaining
+.50 and above	10	115.6	+8.8	100
+.01 to +.49	8	130.0	+6.1	62
−.49 to −.01	5	119.4	+4.6	60
−.50 and below	11	129.0	−1.2	27
	34			

the children with fall V-MA's of −.50 and below, yet their respective IQ changes were +6.1 and −1.2 points. This lack of relationship between fall IQ and IQ change is further shown by a correlation of −.172, not a significant correlation[5] (Table 1). The correlation between fall IQ and fall V-MA was −.283, not significant at the 5% level of confidence.

However, a similar type of arrangement according to size of IQ gain shows that the four children who gained 15 or more points in IQ formed a marked exception to the regular progression in V-MA size with size of IQ change. Examination of the records on these four children has revealed no clue as to the cause of their deviation from the trend.

IQ Change	N	Mean Fall IQ	Mean V-MA	% with Positve V-MA
+15 and above	4	120.3	−.21	50
+10 to +14	6	119.0	+.57	83
+ 5 to + 9	6	120.5	+.40	83
0 to + 4	7	125.7	−.11	43
− 5 to − 1	6	125.5	−.30	33
− 6 or more	5	132.2	−.47	20
	34			

Spring V-MA scores were computed from the spring test scores. There was considerable tendency for the children to maintain their relative positions in V-MA status in the fall and spring, as is evidenced by a correlation of +.727 (Table 1). There was an inverse relationship between fall V-MA status and change in V-MA from fall to spring (r is −.469, significant at the 1% level), indicating that the children with higher V-MA scores in the fall tended to lose some of this superiority during the year.

As regards actual vocabulary status, the positive V-MA group was higher in score on both the fall and spring tests, although they averaged 3.5 months younger than the negative V-MA group. The positive group increased in vocabulary score from fall to spring by 5.8 words and the negative group by 7.6 words. Fisher's *t* for the difference in vocabulary change was 1.28, significant at the 20% level of confidence and not considered a significant difference. It cannot be said, therefore, that the two groups differed with respect to vocabulary change.

Children New to Preschool. Since the previous analyses on vocabulary changes and teacher contacts indicated some differences for children who were new to preschool[6] when compared with the total group, breakdown of the V-MA group was made into those who were new to preschool and those who had been enrolled in preschool in previous years. As will be seen from the following tabulation, differences in IQ change between positive and negative V-MA's were found for both subgroups, although the

[5] In previous preschool groups when the 1916 Stanford-Binet was used, a negative correlation of about −.35 was usually found. Further investigation is needed to determine whether or not a negative relationship will usually be found for Form L. For the 64 children in Part I of this study (including the above 34 children) the correlation between fall IQ on Form L and IQ change was −.002.

[6] A correlation of +.475 was obtained between frequency of teacher contacts and vocabulary change for 18 children, all of whom were in their first year of preschool.

Group	N	Fall CA Mos.	Vocabulary		
			Fall	Spring	Change
Positive V-MA	18	46.9	40.4	46.2	5.8
Negative V-MA	16	50.4	34.1	41.6	7.6
Difference		−3.5	+6.3	+4.6	−1.8
					t=1.28

difference was sharper for the new children than for children previously enrolled.[7]

The 21 children whose vocabulary sigma score was higher than their chronological age sigma score made a mean gain of +4.9 IQ points, and the 13 children whose vocabulary sigma score was lower than their chronological age sigma score made a mean gain of +3.4 points. The t between changes in IQ of these groups was .512, significant at only about the 60% level of confidence. The correlation between size of fall V-CA and IQ change was +.234, not significant at the 5% level of confidence. As would be expected from the high correlation between vocabulary and mental age, the children who were high in vocabulary for their age were considerably higher in IQ than the children who were low in vocabulary for their age. The correlation between fall V-CA and fall IQ was +.565, significant at the 1% level of confidence.

There was no relationship between change in V-CA and change in IQ from fall to spring (r is +.068).

The same considerations held for the

Group	Children New to Preschool			Children Previously Enrolled		
	N	Fall IQ	IQ Change	N	Fall IQ	IQ Change
Positive V-MA	12	118.5	+10.1	6	129.0	+2.7
Negative V-MA	6	119.7	+ 2.0	10	129.8	−0.2
Difference		−1.2	+ 8.1		−0.8	+2.9

Correlations for the children new to preschool are presented in Table 1. The children new to preschool showed somewhat less consistency between fall V-MA and spring V-MA (r is +.555) than the total group.

VOCABULARY-CHRONOLOGICAL AGE STATUS IN RELATION TO IQ CHANGE

When chronological age rather than mental age was considered in relation to vocabulary score, the above type of difference in IQ change tended to disappear. Children whose vocabulary standing in the group was higher than their chronological age standing did not differ significantly in IQ change from those whose vocabulary standing was lower than their chronological age standing.[8]

[7] The finding that IQ gains were greater for new entrants to preschool is in accordance with the findings published in the literature on other groups of children.

[8] It should be kept in mind that V-CA represents relative positions in the two characteristics. It is possible for a child to have a large vocabulary score (say, a score placing him at +2.50 sigma) and yet to be in the negative V-CA group, since his CA sigma score is higher (say, +2.65 sigma score, making the V-CA −.15).

	N	Mean Fall IQ	Mean IQ Change
Positive V-CA	21	128.3	+4.9
Negative V-CA	13	116.8	+3.4
Difference		+11.5	+1.5
			$t = .512$

new entrants and those previously enrolled. The correlation between change in IQ and change in V-CA from fall to spring for new entrants was −.059.

tem of observations and details of the results are given in the first unit of this study. For the 34 children included in the second unit the range of teacher contacts was from 48 to 654, with a mean of 267.9.

In mean number of teacher contacts received during the year the positive V-MA and negative V-MA groups were almost identical. The 18 children with positive V-MA's received on the average 268.6 teacher contacts and the 16 children with negative V-MA's received

	Children New to Preschool			Children Previously Enrolled		
	N	Mean Fall IQ	Mean IQ Change	N	Mean Fall IQ	Mean IQ Change
Positive V-CA	12	124.8	+7.8	9	132.9	+1.1
Negative V-CA	6	107.0	+6.7	7	125.1	+0.6
Difference		+17.8	+1.1		+7.8	+0.5

It appears then, so far as these children are concerned, that simply being high in vocabulary is not the key to IQ change, but that the important pattern is that of vocabulary in relation to mental age.

RELATION OF TEACHER-CHILD CONTACTS TO CHANGING PATTERN OF VOCABULARY-MENTAL AGE STATUS

To what extent are the teacher contacts recorded in this study related to V-MA patterns? Do they have any relation to the manner in which the V-MA patterns changed during the year?

The teacher contacts recorded consisted of instances in which a teacher channelized or structured a situation for a child, gave him help, gave objective information, asked a leading question or gave simple direction. Definitions of these categories, a description of the sys-

267.1 teacher contacts. The correlation between teacher contacts and fall V-MA was −.098. There was thus no particular relationship for the total group between vocabulary-mental age status in the fall and teacher contacts received during the year.

There was, however, a difference in teacher contacts between the children who increased in V-MA status from fall to spring and those who decreased in V-MA status from fall to spring. The 14 children who made positive changes in V-MA from fall to spring received on the average 304.1 teacher contacts and the 20 children who made negative changes in V-MA received 242.6 teacher contacts. The difference in teacher contacts was significant at the 5% level of confidence, t being 2.07.

The correlation between teacher contacts and change in V-MA was positive

	N	Mean No. of Teacher Contacts
Children making positive changes in V-MA from fall to spring	14	304.1
Children making negative changes in V-MA from fall to spring	20	242.6
Difference		+61.5 t=2.07

(+.284) but not significant at the 5% level of confidence, since with this N a correlation of .339 is required for significance at this level.

When the children were classified according to number of teacher contacts received, there was shown to be a regular increase in mean V-MA change with increase in frequency of teacher contacts. The children who received 375 or more teacher contacts changed +.296 in V-MA, those who received 275 to 374 teacher contacts changed +.109 in V-MA, those who received 175 to 274 teacher contacts changed +.001 and those who received less than 175 contacts decreased in V-MA to the extent of −.313. The difference in V-MA change between the two upper groups and two lower groups in teacher contacts was not significant, however, t being 1.71, significant at the 10% level of confidence.

Teacher Contacts	N	Mean Change in V-MA from Fall to Spring
375 and above	5	+.296
275 to 374	12	+.109
175 to 274	8	+.001
Below 175	9	−.313
	34	

t between two upper and two lower groups = 1.71

There was 19 children whose spring V-MA was positive and 15 whose spring V-MA was negative. The positive group had received on the average 290.6 teacher contacts, as compared with 239.2 contacts received by the negative group. The difference yielded at t of 1.09, significant at the 30% level of confidence, and not considered significant.

The findings for the total group, then, indicate a trend for the children who received more teacher contacts to make changes in the direction of greater superiority of vocabulary over mental age. Only one of the comparisons yielded a significant difference, however.

Children New to Preschool. Interpretation of the findings when the group is subdivided into new entrants and previous enrollees is complicated by the uneven number of teacher contacts received by the positive and negative V-MA groups. In the case of new entrants, the positive group received 89.3 fewer teacher contacts than the negative group, while in the case of those previously enrolled the positive group received 116.1 more teacher contacts than the negative group.

For the children new to preschool the correlation between teacher contacts and fall V-MA was −.465, which can probably be considered a significant relationship, a correlation of .468 being required for significance at the 5% level of confidence.

The new entrants who made positive changes in V-MA from fall to spring received +117.4 more teacher contacts than those who made negative changes in V-MA from fall to spring. The t of 2.59 indicates a difference significant at the 2% level of confidence. For those previous-enrolled, there was no difference.

The new entrants who received 275 or more teacher contacts gained +.333 in V-MA from fall to spring, while new en-

	Children New to Preschool		Children Previously Enrolled	
	N	Mean No. of Teacher Contacts	N	Mean No. of Teacher Contacts
Positive fall V-MA	12	225.5	6	354.7
Negative fall V-MA	6	314.8	10	238.6
Difference		−89.3		+116.1

trants who received less than 275 teacher contacts decreased −.432 in V-MA. The difference between these changes in V-MA from fall to spring was +.764 in favor of the children who received the larger number of teacher contacts. The difference was significant at the 2% level of confidence, t being 2.83. For children previously enrolled the change for both groups was small.

this correlation is larger than the correlation between fall V-MA and change in V-MA (r is −.449) and also larger than the correlation between fall V-MA and teacher contacts (r is −.465).

	Children New to Preschool		Children Previously Enrolled	
	N	Mean No. of Teacher Contacts	N	Mean No. of Teacher Contacts
Positive change in V-MA from fall to spring	7	327.0	7	281.3
Negative change in V-MA from fall to spring	11	209.6	9	282.8
Difference		+117.4 t = 2.59		−1.5

In the case of children previously enrolled there was no relationship between teacher contacts and change in V-MA from fall to spring, the correlation being −.003. Compared with the above value

Teacher Contacts	Children New to Preschool		Children Previously Enrolled	
	N	Mean Change in V-MA from Fall to Spring	N	Mean Change in V-MA from Fall to Spring
275 and above	9	+.333	8	−.026
Below 275	9	−.432	8	+.135
Difference		+.765 t = 2.83		−.161

The correlation between teacher contacts and change in V-MA for the new entrants was +.609. It will be noted that +.609 this figure shows a greater effect of teacher contacts on new entrants than on those previously enrolled.

SUMMARY OF VOCABULARY-MA, TEACHER CONTACTS AND IQ CHANGES

The interrelations of teacher contacts, vocabulary-MA and IQ change may be summarized as follows:

(1) Children whose vocabulary in the fall was higher than their mental age gained significantly more in IQ during the year than those whose vocabulary was lower than their mental age.

(2) The above difference was explicit to mental age and tended to disappear when chronological age was substituted for mental age. Children whose vocabulary status in the fall was higher than their chronological age status showed no significant difference in mean IQ change from those whose vocabulary was below their chronological age. There was no relationship between change in vocabulary-chronological age status and change in IQ.

(3) Children who during the preschool year increased their superiority of vocabulary over mental age received significantly more teacher contacts of the type recorded in this study than those who moved in the opposite direction.

(4) Teacher contacts appeared to be more effective in increasing V-MA status for new entrants to preschool than for children previously enrolled.

INTERPRETATION OF V-MA STATUS IN RELATION TO IQ CHANGE

Assuming that the type of relationship between V-MA status and IQ change found for this group of children is not peculiar to this group, but would hold for other similar groups,[9] the situation calls for an explanation in the form of tentative hypotheses which may then be proved or disproved experimentally. Two such hypotheses occur to the authors.

The first hypotheses is that children who are equipped with a high vocabulary are better able to assimilate the preschool experiences, which in general require a high level of understanding and which become more meaningful to those who are better equipped. Against this hypothesis is the finding that a high vocabulary for chronological age was not associated with IQ gain in the same manner as a high vocabulary for mental age.

The second hypothesis is that children who are selected on the basis of high vocabulary in relation to their mental ages are probably relatively less proficient in the nonvocabulary areas of their mental age. The probabilities are, therefore, that their greatest change in mental age will occur in nonvocabulary areas. Since our positive V-MA group made MA changes greater than was necessary to maintain their previous IQ level, the hypothesis might then be advanced that the preschool was stimulating to them (more stimulating than their previous environment had been) in nonvocabulary areas.

It should be possible to make some check on these hypotheses by analysis of subtest performance and by experimental procedures.[10]

The authors have considered a third hypothesis; namely, that social and emotional factors are related to V-MA and may constitute causes that lie behind IQ change. They have not been able as yet to formulate clearly a hypothesis along these lines which fits all the data.

The above are of course intra-group

[9] The authors have inspected some past records of preschool groups who were tested on the Smith-Williams test and on the 1916 Stanford-Binet and find that the same phenomenon holds; i.e., that high V-MA groups gained more in IQ during the preschool year than low V-MA groups. They believe that the relationship is a characteristic one in this preschool setting.

[10] Work has begun along these lines.

comparisons and involve no comparisons of the particular preschool population with outside populations. For example, it is possible that the negative V-MA group may be high in V-MA when compared with an outside population, or that the positive V-MA group may be low in V-MA when compared with an outside population.

The foregoing considerations lead to a tentative hypothesis that the largest contribution of this preschool to IQ gain is in areas other than vocabulary areas. Supporting this hypothesis is the lack of correlation between vocabulary gain and mental age gain, even though vocabulary status is highly related to mental age status. If the hypothesis is verified, it would help to explain why there was little or no relationship between teacher contacts of the type studied here and IQ change, although teacher contacts showed some relation to vocabulary change and to change in vocabulary-mental age status.

The fact that the role of teacher contacts appears to be to place the child in a more favorable V-MA position at the end of the year than at the beginning of the year suggests that for the children thus benefited better IQ gain may follow subsequently. This suggests, too, that there may be a negative relationship between the changes in IQ in successive years of preschool attendance. A check can be made by recourse to data for previous groups of preschool children. Consequently, the data on file on Form L IQ changes were culled for cases falling between the ages of 30 and 53 months on the initial fall test of their entrance year to preschool, who received fall and spring tests during two successive years of enrollment. When the subjects of the present study were omitted, there were found to be 31 such children. The mean entrance IQ was 121.9, the mean change in IQ for the first year of preschool enrollment was +10.3 points and for the second year +2.8 points. The correlation between IQ changes during the first and and second years was negative, −.279. Although this correlation is not signficant at the 5% level of confidence, its negative sign is in accordance with the above hypothesis.

SUMMARY AND CONCLUSIONS

Thirty-four children attending the preschools of the Iowa Child Welfare Research Station were tested on Form L of the 1937 Stanford-Binet and on the Smith-Williams vocabulary test in the fall and spring of the year. They were also observed for frequency of teacher contacts falling into the categories of channelizing or structuring a situation, giving help, giving objective information, asking leading questions and giving simple directions.

A significant relationship was found between vocabulary-mental age status in the fall and IQ change. Children whose vocabulary sigma score in the fall was higher than their mental age sigma score gained significantly in IQ during the year, making a mean gain of +7.6 IQ points, while those whose vocabulary standing was lower than their mental age standing did not change appreciably, their mean change being +0.6 point.

Similar differences were not obtained when vocabulary was considered in relation to chronological age. The children whose vocabulary sigma score was higher than their chronological age sigma score did not differ significantly in mean IQ change from those whose vocabulary was below their chronological age. The correlation between change in vocabulary-chronological age status and change in IQ was +.068.

Children who during the preschool year increased their superiority of vocabulary over mental age tended to receive more teacher contacts of the type recorded in this study than those who moved in the opposite direction. The contacts appeared to be more effective for new entrants than for children previously enrolled. The correlation between teacher contacts and change in vocabulary-mental age status was −.003 for children previously enrolled and +.609 for new entrants.

The tentative hypothesis was advanced that children who are selected on the basis of high vocabulary in relation to mental age make their greatest gain in mental age on nonvocabulary items. Since the children so characterized in this study made significant gains in IQ, the hypothesis is advanced that the preschool was more stimulating to them in nonvocabulary areas than their previous environment had been.

The results of this study suggest that teacher contacts of the type recorded in this study play a definite role in the verbal aspects of mental development particularly of children who are undergoing their first year's experience in this preschool. The results also suggest that the verbal aspects of intelligence are not the aspects in which the preschool is most stimulating to IQ change.